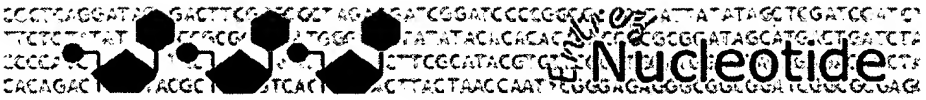


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LOCUS       ECOLAC                  7477 bp    DNA     linear   BCT 05-MAY-1993
DEFINITION  E.coli lactose operon with lacI, lacZ, lacY and lacA genes.
ACCESSION   J01636 J01637 K01483 K01793
VERSION     J01636.1  GI:146575
KEYWORDS    acetyltransferase; beta-D-galactosidase; galactosidase; lac operon;
            lac repressor protein; lacA gene; lacI gene; lacY gene; lacZ gene;
            lactose permease; mutagenesis; palindrome; promoter region;
            thiogalactoside acetyltransferase.
SOURCE      Escherichia coli
  ORGANISM  Escherichia coli
            Bacteria; Proteobacteria; Gammaproteobacteria; Enterobacteriales;
            Enterobacteriaceae; Escherichia.
REFERENCE   1  (bases 1243 to 1266)
  AUTHORS   Gilbert,W. and Maxam,A.
  TITLE     The nucleotide sequence of the lac operator
  JOURNAL   Proc. Natl. Acad. Sci. U.S.A. 70 (12), 3581-3584 (1973)
  MEDLINE   74055539
   PUBMED   4587255
REFERENCE   2  (bases 1246 to 1308)
  AUTHORS   Maizels,N.M.
  TITLE     The nucleotide sequence of the lactose messenger ribonucleic acid
            transcribed from the UV5 promoter mutant of Escherichia coli
  JOURNAL   Proc. Natl. Acad. Sci. U.S.A. 70 (12), 3585-3589 (1973)
  MEDLINE   74055540
   PUBMED   4587256
REFERENCE   3  (sites)
  AUTHORS   Gilbert,W., Maizels,N. and Maxam,A.
  TITLE     Sequences of controlling regions of the lactose operon
  JOURNAL   Cold Spring Harb. Symp. Quant. Biol. 38, 845-855 (1974)
  MEDLINE   74174501
   PUBMED   4598642
REFERENCE   4  (sites)
  AUTHORS   Gilbert,W., Gralla,J., Majors,A.J. and Maxam,A.
  TITLE     Lactose operator sequences and the action of lac repressor
  JOURNAL   (in) Sund,H. and Blauer,G. (Eds.);
            PROTEIN-LIGAND INTERACTIONS: 193-207;
            Walter de Gruyter, New York (1975)
REFERENCE   5  (bases 1146 to 1282)
  AUTHORS   Dickson,R.C., Abelson,J., Barnes,W.M. and Reznikoff,W.S.
  TITLE     Genetic regulation: the Lac control region
  JOURNAL   Science 187 (4171), 27-35 (1975)
  MEDLINE   75048325
   PUBMED   1088926
REFERENCE   6  (bases 1227 to 1271)
  AUTHORS   Gilbert,W., Maxam,A. and Mirzabekov,A.
  TITLE     Contacts between the lac repressor and DNA revealed by methylation
  JOURNAL   (in) Kjeldgaard,N.C. and Maaloe,O. (Eds.);
            CONTROL OF RIBOSOME SYNTHESIS: 138-143;
            Academic Press, New York (1976)
REFERENCE   7  (sites)
  AUTHORS   Marians,K.J. and Brooker,J.D.
  TITLE     Structure of the lactose operator
  JOURNAL   Nature 260 (5549), 360-363 (1976)
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MEDLINE 76150089
PUBMED 768781
REFERENCE 8 (bases 1242 to 1268)
AUTHORS Heyneker,H.L., Shine,J., Goodman,H.M., Boyer,H.W., Rosenberg,J., Dickerson,R.E., Narang,S.A., Itakura,K., Lin,S. and Riggs,A.D.
TITLE Synthetic lac operator DNA is functional in vivo
JOURNAL Nature 263 (5580), 748-752 (1976)
MEDLINE 77056376
PUBMED 1069185
REFERENCE 9 (sites)
AUTHORS Dickson,R.C., Abelson,J. and Johnson,P.
TITLE Nucleotide sequence changes produced by mutations in the lac promoter of Escherichia coli
JOURNAL J. Mol. Biol. 111 (1), 65-75 (1977)
MEDLINE 77168230
PUBMED 323498
REFERENCE 10 (bases 51 to 264)
AUTHORS Steege,D.A.
TITLE 5'-Terminal nucleotide sequence of Escherichia coli lactose repressor mRNA: features of translational initiation and reinitiation sites
JOURNAL Proc. Natl. Acad. Sci. U.S.A. 74 (10), 4163-4167 (1977)
MEDLINE 78052881
PUBMED 337294
REFERENCE 11 (bases 1 to 81)
AUTHORS Calos,M.P.
TITLE DNA sequence for a low-level promoter of the lac repressor gene and an 'up' promoter mutation
JOURNAL Nature 274 (5673), 762-765 (1978)
MEDLINE 78246990
PUBMED 355890
REFERENCE 12 (bases 49 to 1161)
AUTHORS Farabaugh,P.J.
TITLE Sequence of the lacI gene
JOURNAL Nature 274 (5673), 765-769 (1978)
MEDLINE 78246991
PUBMED 355891
REFERENCE 13 (sites)
AUTHORS Miller,J.H., Coulondre,C. and Farabaugh,P.J.
TITLE Correlation of nonsense sites in the lacI gene with specific codons in the nucleotide sequence
JOURNAL Nature 274 (5673), 770-775 (1978)
MEDLINE 78246992
PUBMED 355892
REFERENCE 14 (sites)
AUTHORS Calos,M.P. and Miller,J.H.
TITLE DNA sequence alteration resulting from a mutation impairing promoter function in the lac repressor gene
JOURNAL Mol. Gen. Genet. 178 (1), 225-227 (1980)
MEDLINE 80209248
PUBMED 6770231
REFERENCE 15 (bases 4306 to 5804)
AUTHORS Buchel,D.E., Gronenborn,B. and Muller-Hill,B.
TITLE Sequence of the lactose permease gene
JOURNAL Nature 283 (5747), 541-545 (1980)
MEDLINE 80120651
PUBMED 6444453
REFERENCE 16 (sites)
AUTHORS Miller,J.H., Calos,M.P. and Galas,D.J.
TITLE Genetic and sequencing studies of the specificity of transposition into the lac region of E. coli
JOURNAL Cold Spring Harb. Symp. Quant. Biol. 45 Pt 1, 243-257 (1981)
MEDLINE 82049502
PUBMED 6271472

REFERENCE 17 (sites)
AUTHORS Chenchick,A., Beabealashvilli,R. and Mirzabekov,A.
TITLE Topography of interaction of Escherichia coli RNA polymerase subunits with lac UV5 promoter
JOURNAL FEBS Lett. 128 (1), 46-50 (1981)
MEDLINE 82004657
PUBMED 7023981
REFERENCE 18 (sites)
AUTHORS Betz,J.L. and Sadler,J.R.
TITLE Variants of a cloned synthetic lactose operator. I. A palindromic dimer lactose operator derived from one stand of the cloned 40-base pair operator
JOURNAL Gene 13 (1), 1-12 (1981)
MEDLINE 81213459
PUBMED 7016667
REFERENCE 19 (sites)
AUTHORS Sadler,J.R. and Tecklenburg,M.
TITLE Cloning and characterization of the natural lactose operator
JOURNAL Gene 13 (1), 13-23 (1981)
MEDLINE 81213463
PUBMED 6263752
REFERENCE 20 (sites)
AUTHORS Betz,J.L. and Sadler,J.R.
TITLE Variants of a cloned synthetic lactose operator. II. Chloramphenicol-resistant revertants retaining a lactose operator in the CAT gene of plasmid pBR325
JOURNAL Gene 15 (2-3), 187-200 (1981)
MEDLINE 82051311
PUBMED 6271642
REFERENCE 21 (sites)
AUTHORS Calos,M.P. and Miller,J.H.
TITLE The DNA sequence change resulting from the IQ1 mutation, which greatly increases promoter strength
JOURNAL Mol. Gen. Genet. 183 (3), 559-560 (1981)
MEDLINE 82147746
PUBMED 7038381
REFERENCE 22 (sites)
AUTHORS Mieschendahl,M., Buchel,D., Bocklage,H. and Muller-Hill,B.
TITLE Mutations in the lacY gene of Escherichia coli define functional organization of lactose permease
JOURNAL Proc. Natl. Acad. Sci. U.S.A. 78 (12), 7652-7656 (1981)
MEDLINE 82150928
PUBMED 6278484
REFERENCE 23 (sites)
AUTHORS Russell,D.R. and Bennett,G.N.
TITLE Construction and analysis of in vivo activity of E. coli promoter hybrids and promoter mutants that alter the -35 to -10 spacing
JOURNAL Gene 20 (2), 231-243 (1982)
MEDLINE 83158761
PUBMED 6299890
REFERENCE 24 (sites)
AUTHORS Horowitz,H. and Platt,T.
TITLE A termination site for LacI transcription is between the CAP site and the lac promoter
JOURNAL J. Biol. Chem. 257 (19), 11740-11746 (1982)
MEDLINE 83007251
PUBMED 6288696
REFERENCE 25 (sites)
AUTHORS Klein,R.D. and Wells,R.D.
TITLE Effects of neighboring DNA homopolymers on the biochemical and physical properties of the Escherichia coli lactose promoter. I. Cloning and characterization studies
JOURNAL J. Biol. Chem. 257 (21), 12954-12961 (1982)
MEDLINE 83030833

PUBMED 6290487
REFERENCE 26 (bases 1183 to 1291)
AUTHORS Weiher,H. and Schaller,H.
TITLE Segment-specific mutagenesis: extensive mutagenesis of a lac promoter/operator element
JOURNAL Proc. Natl. Acad. Sci. U.S.A. 79 (5), 1408-1412 (1982)
MEDLINE 82174608
PUBMED 7041119
REFERENCE 27 (sites)
AUTHORS Van Dyke,M.W. and Dervan,P.B.
TITLE Footprinting with MPE.Fe(II). Complementary-strand analyses of distamycin- and actinomycin-binding sites on heterogeneous DNA
JOURNAL Cold Spring Harb. Symp. Quant. Biol. 47 Pt 1, 347-353 (1983)
MEDLINE 83233528
PUBMED 6305557
REFERENCE 28 (bases 1287 to 4364)
AUTHORS Kalnins,A., Otto,K., Ruther,U. and Muller-Hill,B.
TITLE Sequence of the lacZ gene of Escherichia coli
JOURNAL EMBO J. 2 (4), 593-597 (1983)
MEDLINE 84028567
PUBMED 6313347
REFERENCE 29 (sites)
AUTHORS Cone,K.C., Sellitti,M.A. and Steege,D.A.
TITLE Lac repressor mRNA transcription terminates in vivo in the lac control region
JOURNAL J. Biol. Chem. 258 (18), 11296-11304 (1983)
MEDLINE 83291093
PUBMED 6309841
REFERENCE 30 (sites)
AUTHORS Sadler,J.R., Sasmor,H. and Betz,J.L.
TITLE A perfectly symmetric lac operator binds the lac repressor very tightly
JOURNAL Proc. Natl. Acad. Sci. U.S.A. 80 (22), 6785-6789 (1983)
MEDLINE 84070714
PUBMED 6316325
REFERENCE 31 (sites)
AUTHORS Glickman,B.W. and Ripley,L.S.
TITLE Structural intermediates of deletion mutagenesis: a role for palindromic DNA
JOURNAL Proc. Natl. Acad. Sci. U.S.A. 81 (2), 512-516 (1984)
MEDLINE 84119517
PUBMED 6582506
REFERENCE 32 (sites)
AUTHORS Spassky,A., Kirkegaard,K. and Buc,H.
TITLE Changes in the DNA structure of the lac UV5 promoter during formation of an open complex with Escherichia coli RNA polymerase
JOURNAL Biochemistry 24 (11), 2723-2731 (1985)
MEDLINE 85280412
PUBMED 3896305
REFERENCE 33 (sites)
AUTHORS Straney,D.C. and Crothers,D.M.
TITLE Intermediates in transcription initiation from the E. coli lac UV5 promoter
JOURNAL Cell 43 (2 Pt 1), 449-459 (1985)
MEDLINE 86079527
PUBMED 2416465
REFERENCE 34 (sites)
AUTHORS Looman,A.C., de Gruyter,M., Vogelaar,A. and van Knippenberg,P.H.
TITLE Effects of heterologous ribosomal binding sites on the transcription and translation of the lacZ gene of Escherichia coli
JOURNAL Gene 37 (1-3), 145-154 (1985)
MEDLINE 86031346
PUBMED 3932130
REFERENCE 35 (sites)

AUTHORS Mandecki,W., Goldman,R.A., Powell,B.S. and Caruthers,M.H.
TITLE lac Up-promoter mutants with increased homology to the consensus promoter sequence
JOURNAL J. Bacteriol. 164 (3), 1353-1355 (1985)
MEDLINE 86059235
PUBMED 2999082

REFERENCE 36 (sites)
AUTHORS Malamy,M.H., Rahaim,P.T., Hoffman,C.S., Baghdoyan,D., O'Connor,M.B. and Miller,J.F.
TITLE A frameshift mutation at the junction of an IS1 insertion within lacZ restores beta-galactosidase activity via formation of an active lacZ-IS1 fusion protein
JOURNAL J. Mol. Biol. 181 (4), 551-555 (1985)
MEDLINE 85210885
PUBMED 2987506

REFERENCE 37 (bases 5646 to 7477)
AUTHORS Hediger,M.A., Johnson,D.F., Nierlich,D.P. and Zabin,I.
TITLE DNA sequence of the lactose operon: the lacA gene and the transcriptional termination region
JOURNAL Proc. Natl. Acad. Sci. U.S.A. 82 (19), 6414-6418 (1985)
MEDLINE 86016712
PUBMED 3901000

COMMENT Original source text: Escherichia coli DNA; mRNA; clone lambda-h80dlac DNA; clone puk217; pgm8 (see comment).
[3] sites; UV5 mRNA transcripts and operator mutants. [(in) Sund,H. and Blauer,G. (eds.);Protein-Ligand Interactions: 193-207;Walter de] sites; operator mutational analysis. [7] sites; S1 and mung bean nuclease action on operator DNA. [9] sites; class I, II and III promoter mutant analysis. [13] sites; lacI mutant analysis.
[16] sites; Tn5, Tn9 and Tn10 insertion sites in lac region. [14] sites; lacI promoter mutation UJ177.
[18] sites; palindromic dimer operator;.
[19] sites; natural operator sequence.
[20] sites; operator mutational analysis.
[21] sites; lacI-Q deletion.
[17] sites; RNA polymerase UV5 promoter interaction. [22] sites; lacY mutational analysis.
[24] sites; lacI-promoted transcription termination. [25] sites; wt and UV5 promoter sequence studies. [23] sites; UV5 promoter mutational analysis.
[30] sites; perfectly symmetric operator sequence. [29] sites; lacI mRNA termination site.
[27] sites; distamycin and actinomycin binding to promoter. [31] sites; lacI deletion studies.
[35] sites; promoter mutational studies.
[33] sites; DNAase I studies with promoter sequence. [34] sites; ribosomal binding and translation initiation for lacZ. [36] sites; insertion sequence IS1 integration in lacZ;. [32] sites; DNAase I studies with promoter.
[1] first reports a 27 bp operator(sites 1240-1266) with two-fold symmetries; the operator has also been defined to be bases 1246-1266 or bases 1239-1273 [8]. [(in) Kjeldgaard,N.C. and Maaloe, O.(eds);Control of ribosome synthesis: 138-143;A] explores the ability of lac
repressor protein to affect methylation of operator DNA. [8] argues that DNA on both sides of the 21 bp operator (bases 1246-1266) affects repressor binding but that the sequences of this DNA are probably not critical. [5] gives a larger sequence known as the promoter-operator region for the wild-type, whereas [2] and [26] give portions of this region for the mutant strain UV5. Within the promoter region, bases 1162-1199 are identified as the catabolite gene activator protein binding site (cap) and bases 1200-1245 are the RNA polymerase interaction site. [10] reports a

sequence for the 5'end of the lacI (repressor) gene and discusses restart in mutant strains. [11] presents a sequence for the lacI promoter region and identifies an I-Q mutation which enhances lacI transcription approximately ten-fold. [12] gives a complete sequence
for lacI which agrees with the known lac repressor sequence. [26] examines the promoter-operator region in the UV5 strain (lac109) and studies 23 mutant derivatives of this sequence. This sequence agrees with known protein sequences for the lacZ, lacY and lacA enzymes. [15] notes that the fMet codon is not present
for lacA and suggests that the 'ttg' codon (5727-5729), which immediately precedes the mature N-terminal asparagine codon, is the start codon. The cds for lacZ, lacY and lacA are included on a single mRNA transcript.
Complete source information:
Escherichia coli DNA [1],[(in) Kjeldgaard,N.C. and Maaloe,O.(eds); Control of ribosome synthesis: 138-143;A],[8],[12],[26]; mRNA [2], [5],[10]; clone
lambda-h80dlac DNA [11],[15]; clone puk217 [28]; pgm8 [37].

FEATURES Location/Qualifiers

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variation 1209..1211
/note="gct in wild-type; gt in mutant l305 [5]"

variation 1212
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variation 1230
/note="c in wild-type; a in mutant p-r-1a [5]"

variation 1237..1238
/note="gt in wild-type; aa in strain UV5 [26]"

variation 1242..1245
/note="gtgg in wild-type; ttca in synthetic operator [8]"

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variation 1267..1268

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